Dear present and future GOHNET members!

This fourth GOHNET Newsletter focuses on ergonomic issues in general and musculoskeletal disorders (MSDs) in particular. The term ergonomics is based on the Greek term ‘ergon’ (work) and ‘nomos’ (law) to denote the science of work.

In general, it is well known that work-related problems due to ergonomic conditions, if not prevented or treated in time, result in a deteriorated health status and unnecessary suffering for affected individuals and their families. They will also result in increased costs for these parties, as well as for their employer and eventually the society. For example in the United States, low back pain results in ten million people off work daily. A total annual societal cost of back pain in the United States range from US$20 to $50 billion. Adopting basic ergonomic principles is therefore an important measure and in everybody’s interest.

The recently released WHO World Health Report (http://www.who.int/whr/en/) includes data on the Burden of Disease of occupational exposure. It supports the fact that ergonomic stressors at work represent an important risk factor for low back pain.

Reliable and scientific data on other forms of MSDs are still scarce at the present time. Some reasons for this will become clear once you have read this newsletter.

Research results, suggestions and recommendations are provided in the articles included in this newsletter from research in Germany, Hungary and South Korea. A comparison study between workers in the Czech Republic and the United States brings up some interesting research and assessment issues which are shortly discussed.

Also, at present, several WHO Collaborating Centres are developing documents on prevention, treatment and rehabilitation of MSDs. The brochure entitled Preventing MSDs in the Workplace is to be launched this spring by WHO in collaboration with two of our German Collaborating Centres. A summary description of the content is presented in this newsletter.

For any suggestions or contributions to future topics or discussions on the current topic, please write to:

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The current situation of musculoskeletal disorder in South Korea

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Recently, the incidence rates of cumulative trauma disorders (CTDs) or musculoskeletal disorders (MSDs) have rapidly increased in Korea. In 1993, it recognized cervicobrachial disorders as an occupational disease under the Workers’ Compensation Law. It is quite a new phenomenon but rates are much higher than other occupational diseases. Consequently, it has drawn much attention from various sectors such as labour unions, employers, government, academic circles and industrial health groups.

The MSD situation in Korea

In Korea, the rate of MSDs prior to 1998, was relatively low. Since that time, the rate has increased due to both higher accident rates and larger number of incidents caused by stressful working conditions.

Specifically, cases of MSD, were relatively low in 1993, but increased steadily through 1996. Then during the financial crisis years of 1997 and 1998, the rate decreased. Thereafter, the number of cases rapidly increased to where currently the rate has reached around 30% of the total work-related diseases.

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The rate of MSDs in Korea is characterized by the irregular number of cases from year to year with large increases and decreases.

**Irregularities in MSD rates**

A possible cause of such inconsistencies could be due to the lack of confirmation criteria in diagnosing MSDs and even the questionable diagnoses process itself within the special health examination. Additional factors could be that many employees do not report their pain and discomfort for fear of being dismissed or laid off from their jobs, especially during economic hard times. Moreover, MSDs were not fully recognized as a legitimate disorder until recently. These factors could explain the inconsistent reported rates of this disorder.

The prevalence rate of MSDs in Korea is still low compared to that of developed countries. Since 1990, the rates of MSDs account for 61–65% of all occupational cases in USA. There are various differences in the confirmation criteria of occupational disease, working conditions, racial differences, as well as differences in working hours between Korea and USA. However I would agree that the rate of MSDs will increase as Korea visibly moves towards becoming a developed country.

**Sectors studied**

The study of MSDs in Korea started with telephone operators in 1989 and since 1990 it expanded into the service sector. This sector includes workers such as banking service operators, office workers, musicians, hairdressers, and dental health care workers. These investigations have been extended to those working in the production sector, such as packaging service workers, automobile assembling workers, microwave assemblers, electronic parts assemblers, ship building workers, meat processing and packaging workers and similar occupations. So far, the research has been conducted according to various job types but there is still much more research to be done.

According to the analysed data of types of MSD’s and characteristics in Korea, 57.3% of cases are in the manufacturing industry, such as in the manufacture of automobiles and trailers and transporting equipment. 11.2% are in the transportation industry and 6.1% in the construction industry. However, there are big differences between the number of actual and recognized cases.

Considering these facts, only a few jobs are recognized as causing occupational diseases that are related to MSDs. The developed countries reported higher rates of cases in industries such as meat processing, tailoring and in the service sectors, but there are still only a few cases recognized in some industries in Korea.

Therefore, it is recommended for Korea to implement a monitoring system for MSDs at the national level and to complement the system with recording cases and reported occurrences in detail.

**Rapid increase in the occurrence of MSDs**

The rapid increase in the number of reported cases of MSDs could be explained by changes in social conditions in Korea. Also, the Korean Government has given closer attention to industrial hazards which in turn have focused on MSDs during labour negotiations between labour unions and management.

More direct factors that contribute to rapid increases of reported MSD cases are as follows:

- diversification of the work environment
- increase in repetitive motion work due to rapid increase in computer usage;
- inadequate working posture;
- work environment factors such as increase in working speed in manufacturing assembly lines;
- increase in noise;
- low temperature environments.

This paper agreed that the rates of MSDs are increasing yearly due to occupational factors and that the increase is very steep. Moreover, at present, there are increasing possibilities of high occurrences rather than a reduction. This has also happened in advanced countries.

**Recommendations**

It is suggested, therefore, that we inspect, evaluate and diagnose the essential problems and provide adequate and early alternatives such as applying adequate managing programmes. It is also recommended for both workers and employers to revise their recognition of MSDs along with regulation amendments.

The study of MSDs in Korea has concentrated on only a limited number of jobs, it should, however, be expanded to a range of various jobs. Intervention research or tracking research should be applied to determine causes. A fundamental basis for efficient solutions and management needs to be set up. It is further suggested that the monitoring systems, together with recording disease types be implemented, as well as complementary regulation systems.

The major factor contributing to the occurrence of occupational MSDs is related to work. It is necessary to design human work environments to be more ergonomic by reducing poor posture situations and avoiding insufficient power to control the frequency of repetitive motion, and by setting aside enough breaks during working hours.

In short, it is recommended that design and working conditions be made suitable for Korean workers’ physical characteristics and capabilities.

Lastly, it is necessary to find solutions to minimize effects
of work-related factors as those mentioned earlier, while considering that also social, psychological and personal factors affect occurrences of MSD, even if to a lesser degree.

Musculoskeletal disorders caused by hand-arm vibration

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Work-related musculoskeletal disorders are one of the most common, potentially disabling professional diseases. In the USA 332,000 new cases were reported in 1994 and 308,000 in 1995 respectively. In 1995 the workers’ compensation costs were 2.1 billion dollars (1,2).

One of their causes can be the exposure to vibration, which has two main forms: hand-arm and whole-body vibration. Both of them can induce musculoskeletal disorders.

The first pneumatic tools representing hand-arm vibration exposure were introduced in French mines in 1839 (3). The vibration-induced symptoms (Raynaud’s phenomenon) were described first in 1911 by Loriga (4), but the osteoarticular alterations by Holtzmann (5) in 1926.

Since 1929, these changes are recognised as occupational diseases liable to worker compensation in Germany (6). Since 1983 the symptoms and signs caused by hand-arm vibration are summarised as hand-arm vibration syndrome (7). The syndrome consists of three main components: vascular, neurological and musculoskeletal (8).

In 1996 the number of persons exposed to hand-arm vibration in Great Britain was 1.2 million. However, nowadays there are 3,000 new cases of hand-arm vibration syndrome. It is the most common recorded professional disease, as 14% of those patients are left disabled (9).

In the following we summarise the musculoskeletal disorders associated with hand-arm vibration exposure.

Musculoskeletal disorders caused by hand-arm vibration exposure

The scientific literature indicates that work incapacity due to musculoskeletal disorders is compensated in many countries (3). However, Gemme and Saraste (1987) suggest, on the basis of the of a literature review, that there exists only evidence in the case of pneumatic percussive tools regarding the association between premature elbow and wrist osteoarthrosis of very low prevalence and the exposure to low-frequency percussion. They further believe that the excess prevalence of bone cysts, Kienbäck’s disease or pseudoarthrosis of the scaphoid has not been validly documented in vibration-exposed populations. In addition, they experienced that the exposure to vibration of higher frequencies (rotating tools, chain saws, and similar) does not cause excess bone and joint pathology (6).

On the basis of our own experiences (10,11) we do not agree with Gemme and Saraste, because we observed significant osteoarticular alterations on the basis of vibration caused by electric saws and grinders. In addition, we recently found, while examining 107 ore miners, that there were eleven cases (10,3%) of Kienbäck’s disease compared to 0 percent in the control group consisting of 450 males (unpublished data).

Our Hungary-based results suggest that the frequency of osteoarticular abnormalities also depends on the effectiveness of the diagnostic methods applied. Using high resolution computer tomography (HRCT) and/or magnetic resonance imaging (MRI), while applying the staging schema of necrosis of Bohndorf (1998) and Miller (1999) we could visualise more aseptic necroses and osteochondroses dissecans at an earlier stage than we could by means of conventional radiography (12,13). The accuracy of these up-to-date diagnostic methods can help in the monitoring of progression or regression of osteoarticular diseases and in estimating the maximum permissible physical load of the affected extremities (14,15).

The contradictory data found in the literature can be explained by some confounding factors.

– First of all, the composition of the examined groups according to occupations is very heterogeneous. Consequently, also the parameters of the vibration, the physical load and the posture required are divergent. Moreover, the differences in the working conditions can result in very different pathological alterations.

– Secondly, the authors can interpret the findings differently.

– Thirdly, the collection of an adequate control group is rather difficult in this field, because the examination represents also radiation exposure for healthy people, which is problematic from ethical point of view.

– Finally, working with vibrating tools can represent not only hand-arm vibration exposure but also heavy manual work in general, which may take place in bent, twisted, extended or inclined postures. This alone can induce musculoskeletal disorders or influence the vibration-related disorders.

Wrist region

Ninety percent of the hand-transmitted vibration is absorbed at the level of the carpal joint (10). Therefore, vibration-related osteoarticular alterations are more frequent is this region.
The scientific literature indicates incidence of cysts and vacuoles in carpal bones described as characteristic alterations for hand-arm vibration exposure. However, their incidence in workers not using vibrating tools is the same, which indicates that a casual relationship can be excluded (10).

In addition, the occurrence of the radiocarpal osteoarthrosis is not more common among workers using vibrating tools than among workers doing heavy manual work (10).

Intercarpal osteoarthrosis occurs practically only as secondary consequence of aseptic necroses of the carpal bones.

On the contrary, distal radioulnar osteoarthrosis seems to indicate a causal relationship with exposure to the hand-arm vibration. Its radiological signs were found in 44 percent of motor saw operators in contrast to 13 percent of individuals in the control group (10). Moreover, Wette (1931) suggested the etiological role of hand-arm vibration exposure in the development of aseptic necroses of the carpal bones (Kienböck’s disease, pseudoarthritis of scaphoid)3. The hypothesis was confirmed by Andréessen (1938) and Hagen (1947, 1963). The latter observed lunatum necrosis in 20 percent of his miner patients. Later Laarmann (1970) experienced a very low occurrence (0.01-0.02 %) and emphasised the role of the physical constitutional factors. Our results support the causal role of hand-arm vibration exposure, since the incidence of aseptic necrosis of the carpal bones was 19.3 % in coal miners (10) and 17.5 % in motor saw operators (unpublished data) compared to 0 % in the control group (10). We also have found aseptic necrosis (16) in 05 triquetrum and capitatum.

In examining x-rays we have observed chronic hypertrophic osteoarthrophy in the carpal bones and in the carpal epiphysis of the radius and ulna. It is a functional adaptation of the bone structure to the aphysiological load caused by vibration. This disorder occurred in 26.6 percent of 844 workers of 7 different occupations (minimum 10.7, maximum 40.0 percent) examined because of suspicion of hand-arm vibration syndrome (10).

Moreover, Bugyi (1972) described the lesion (cyst formation, subsequently fracture, finally ankylosis and necrosis) of the ulnar processus styloideus. This special sort of lesion can be attributed to a special kind of work (17).

Dupuytren’s contracture was considered for decades as a disease of constitutional origin. Lately it was found that it occurs in workers using vibrating tools 2.1-2.6 times more frequently than in the average working population. This fact suggests an association between hand-arm vibration exposure and Dupuytren’s contracture (18).

The last wrist-related disorder to be discussed here is carpal tunnel syndrome. It is the most common work-related disease in the USA caused by hand-arm vibration exposure or repetitive movements of the wrist. It is one of the most disabling and costly work-related diseases and represents a major cause of lost work days and workers’ compensation costs (1).

Elbow region
The low frequency vibration transmitted to the upper limbs can induce resonance by about 10-20 Hz in the wrist and elbow joint which may contribute to the development of musculoskeletal disorders (3). The latter is influenced also by the worker’s muscular strength. Operators with strong muscles are better able to resist the vibration and so protect the articular surfaces from the impacts generated by the percussive tools. Periarticular alterations in these persons are observed. Workers with weaker muscles mainly experience damage to articular surfaces due to the impact (19).

Hagen (1947, 1961) observed that the osteoarthrosis of the elbow joint was by far the most frequent (82.7 %) vibration-induced lesion in patients working as miners (19,24). Recently, we found the incidence of this alteration in Hungarian ore miners to be 19.6 percent. The reduction of morbidity must presumably be attributed to the technical improvement of the tools. Osteoarthrosis can occur also in heavy manual workers not using vibrating tools. Therefore its cause can not exclusively be the exposure to hand-arm vibration (10). It is, however, probable that it is the result of the combined effect of microtraumatisation, heavy manual work and bent, twisted, extended or inclined body posture. No osteoarthrosis of the elbow was encountered amongst the light manual and office workers (20). The osteoarthrosis can cause secondary ulnar neuropathy (21).

It was first raised by Rostock (1942) that the osteochondrosis dissecans represents the most characteristic vibration-induced damage of the elbow joint (22). Its incidence in Hungarian ore miners was 4.7 percent. For its diagnosis the HRCT and MRI examination are useful tools. Osteochondrosis dissecans is a leading cause of permanent elbow disability (23).

The periarticular changes (ossification of triceps tendon, calcification in the environment of epicondyles) are the consequences of strenuous manual work in occupations using pneumatic tools (8). Their occurrence amongst Hungarian ore miners was 13.1 percent in 2000.

Shoulder region
The data of the literature suggest generally that the vibration-induced damages of the shoulder region are rather rare. To the contrary, we found that amongst the Hungarian ore miners the osteoarthrosis of this region was the most frequent (31.8 %). Osteoarthrosis of the acromioclavicular joint was more common (19.6 %) than that of the humeroscapular one (12.1 %). The total
osteoarthrosis morbidity of this population was 39.2%. The frequent occurrence of degenerative lesions of the acromioclavicular joint of the miners was described also by other authors (24, 25). It seems to be a characteristic sign of hand-arm vibration syndrome of the miners.

Risk for tendinitis of the shoulders due to rockblasters were published as a combined effect of heavy manual work and exposure to hand-arm vibration (26).

**Fatigue fracture of the spinous process**
This alteration on the spinous process of one of the vertebrae cervical V-dorsal I was observed in 1.9 percent of 844 Hungarian workers using vibrating tools. It considerably exceeded the incidence observed by people working with shovels, but caused no symptoms (10).

**Conclusions**
Vibration-related musculoskeletal disorders are rather frequent professional diseases. They injure first of all the musculoskeletal system of the upper extremities and can cause disability. This latter fact is very important, because the upper limbs are the main devices for manual work. The prevention of the vibration-related musculoskeletal disorders is an important task of industrial hygienists. The methods of the prevention are reasonable technical and other prophylactic measures, among others pre-employment and periodic medical examinations.

**Abbreviations**
HRCT: high-resolution computer tomography
MRI: magnetic resonance imaging

**Explanations** (footnotes)
1. osteoarthrosis: degenerative lesion of the joint
2. Kienböck’s disease, pseudoarthrosis of the scaphoid: osteonecrotic alterations in the carpal bones.
3. staging schema of necrosis:
4. aseptic necrosis: osteonecrosis due to noninfective cause
5. osteochondrosis dissecans: circumscribed necrosis of the subchondral bone with consecutive dissection of the particles of the articular surface and development of articular loose bodies
6. cysts and vacuoles: circumscribed radiolucent areas in the bones
7. radiocarpal osteoarthrosis: degenerative lesion of the radiocarpal part of the wrist joint
8. intercarpal osteoarthrosis: degenerative lesion of the carpal bones
9. distal radioulnar osteoarthrosis: degenerative lesion of the radioulnar part of the wrist joint
10. lunatum necrosis: necrosis of the semilunar bone
11. os triquetrum and capitatum: carpal bones

12. chronic hypertrophic osteoatrophy: rarefaction of the bone trabeculas and the thickening of the residual ones
13. carpal epiphysis of the radius and ulna: the distal part of the forearm bones
14. ulnar processus styloideus: the distal process of the one of the forearm bones
15. periarticular alteration: damage, often calcification of tendons, their insertions and the periosteum localised in the environment of the joint
16. ulnar neuropathy: lesion of the ulnar nerve
17. acromioclavicular joint: a part of the shoulder joint (articulation between the collar bone and the shoulder blade)
18. humeroepicondylar joint: another part of the shoulder joint (articulation between the humerus and the shoulder blade)

**References**
Prevalence of low back pain and disability in bank office workers in western Tehran

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Introduction
Low back pain is one of the most common disorders (3). It affects up to 85 percent of the working population at least once in their life, and each year about 14 percent experience back pain lasting at least two weeks. This is the fifth leading cause for visiting the doctor and the leading cause of work-related disability. (6) One in four American workers experience low back pain each year and for up to 8 percent of these workers the pain is disabling. (6) This problem is the second most common symptom-related reason for visiting physicians. (15)

Surveys suggest that the lifetime incidence of LBP ranges from 60-90 percent with a 5 percent annual incidence. For persons younger than 45 years, mechanical low back pain represents the most common cause of disability (15), and it is the third most common cause of disability in persons aged older than 45 years. (9) Low back pain occurs most frequently in people between the ages of 20 and 40, but is more severe among older patients. (3)

Some Researchers have not found any relation between low back pain and gender, body weight, height, or level of physical fitness, whereas others have. (17, 3)

It is important to notice that despite the level of discomfort, 90 percent of those who develop low back pain recover spontaneously within four weeks, and only 5 percent remain disabled longer than three months. (3)

The cost of low back pain
The total cost in lost productivity is enormous. Back pain is the second leading cause of absenteeism from work, after the common cold and accounts for 15 percent of sick leave. (15, 8) It is estimated to cost up to $50 billion in the USA with a $14 billion in lost productivity per year. (12)

Studies have found that when people stay home because of back injury, only 65 percent are back at work within a week and nearly 14 percent are still absent one month later. And, if someone is on disability for a year or longer for low back pain, there is only a 25 percent chance that the patient will return to work. (12) The cost of treating patients with low back pain has increased by 241 percent during the last decade. (6) Estimates of total costs of direct medical and indirect expenses for low back pain in the United States range from $20 to $100 billion annually. (6) Spine care results in expenditures two to three times greater than cardiac services for many health plans. (6)

Research has indicated that low back pain disability is growing 14 times faster than the population. It is the leading cause of disability and morbidity in middle-aged persons, and is the most expensive source of workers’ compensation costs in North America. In the 30-50 age groups, low back pain is the single most expensive health care problem. (10)

Low back pain accounts for 33 percent of all workers’ compensation costs (one-third for medical treatment, two-thirds for indemnity). (4) In addition, 75 percent of compensation payments go to patients with low back pain,
yet they constitute only three percent of all patients receiving compensation. (2)

An estimated 93 million workdays may be lost each year as a direct result of low back pain. (11) Back injuries cause 100 million lost days of work annually, and are the most costly injury for employers. (7)

Risks at work
Workplace risk factors that can contribute to low back pain include bad posture while sitting or standing for long periods of time, driving long distances, improper seating and lifting techniques, frequent lifting or lifting of too heavy loads, and whole-body vibration. These factors explain why the workplace is often the setting in which underlying weakness or other problems with the low back first make themselves known. (15, 4)

Many people think of heavy lifting as the main cause of low back pain in the workplace, but poor posture while sitting, especially for long periods of time, is just as important. Back pain is as common among clerical workers in jobs requiring prolonged sitting as in workers whose jobs require heavy lifting. (4)

Psychological factors can also contribute to low back pain. These include stress, job dissatisfaction, boredom, tension, and other psychological factors that can affect the way workers physically carry out their responsibilities, as well as how the body responds to the everyday physical demands of the job. (4, 14)

Certain personal habits may also lead to repetitive strain injury at work or in the home, such as for example drinking alcohol. Alcohol abuse may lead to tripping and falls and may result in back pain. (4)

High risk occupations include miscellaneous labour, such as garbage collection, warehouse work, nursing, as well as vocations that are usually associated with lifting, twisting, bending, and reaching.

Physical examinations
The history and physical examinations are the most important components of the initial evaluation of the patient with back pain. (1) As there are a multitude of causes for low back pain, for patients with acute low back pain, a precise etiology can be identified in only about 15 percent of cases. (1) An interval of four weeks before considering special tests allows 90 percent of patients to recover spontaneously and avoids unneeded procedures. (3) Imaging may also be performed for medico-legal reasons in selected cases and for those whose health status does not improve. (2)

In general, many episodes of workplace back pain are not attributable to high peak workloads, repetitiveness of lifts, or large loads. Work posture and resting posture may impair disc nutrition and increase stress on the posterior articularations. In addition, some workers may overly contract muscles in the performance of a work effort. Thus, back pain is as common among clerical workers in jobs requiring prolonged sitting as in workers whose jobs require heavier workloads. (2)

Material and method
438 office workers (bank personnel) from the western part of Tehran entered our study according to simple randomized selection. People who were excluded from the study were those with previous back disorders, accountants, file clerks and servants. The prevalence of low back pain was estimated by using a questionnaire. The prevalence of disability was estimated by means of the “Oswestry” questionnaire. Measured variables were: age, sex, weight, height, present low back pain and its duration, previously experienced low back pain, smoking habits, using foot and arm rests, the duration of sitting, job satisfaction, seating comfort, performing a second job, and job flexibility.

Results
The prevalence of low back pain was 33.3 percent in our study, with a mean age of 34.98 years. The mean duration of low back pain was 1.43 years, the mean percent of disability was 8.74 percent, and mean duration of sitting was 5.92 hours. In this study low back pain was significantly related to age (P=.034), the duration of sitting (P=.015), and the working history (P=.014). Also the use of foot rests has been shown to be significantly related to reduced low back pain. Odds ratios were for

- male gender: 0.567 (95%CI 0.352-0.913),
- job flexibility 0.570 (95%CI 0.370-0.878),
- seating comfort 0.472 (95%CI 0.315-0.709),
- the use of foot rests 1.789 (95%CI 1.198-2.672), and
- working history 2.814 (95%CI 1.595-4.966) respectively.

Discussion and conclusion
Low back pain is prevalent in office workers in banks in Tehran. It causes high disability and costs, although it can easily be prevented and managed through simple practical ergonomic and administrative actions.

Proper body posture and joint positioning with the help of proper foot rests and well-designed work-rest cycles are the most important actions which reduce local joint stress and preserve joint integrity. These simple actions reduce the prevalence and costs of low back pain.

References:
1 James R Lehrich, MD Jeffrey N Katz, MD Robert P Sheon, MD
Some current research issues:

A study has been conducted comparing the occurrence and other characteristics of carpal tunnel syndrome (CTS) cases acknowledged as an occupational disease in Albany, NY (group A) and Prague, Czech Republic (group P) in the year 1996.

The two groups differed in several aspects. For example, in comparison with group A, group P showed a higher proportion of men, a higher mean age at the time of establishing the diagnosis, a longer mean duration of exposure, a longer time span between the appearance of the first CTS symptoms and establishing the diagnosis, and a higher proportion of CTS cases with severe abnormalities of nerve conduction velocity.

In group A, CTS developed in 90% of cases as a result of highly repetitive light movements, whereas in group P it resulted from heavy physical work in 98% of cases.

The results clearly documented variations between countries in the patterns of occurrence and other characteristics of occupational CTS cases. The study illustrates that international comparability of various health indicators, such as the number of reported occupational diseases, is quite problematic. It furthermore stresses the need for international standardization of diagnostic criteria and methods of data analysis.

Launch: Brochure in the Protecting Workers’ Health series

Preventing Musculoskeletal Disorders in the Workplace
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The brochure provides basic information about the relevant risk factors that contribute to the development of musculoskeletal diseases. It may thus enable employers, supervisors, and occupational health trainers to recognize the risks at the workplace and to design work and work environment, as well as information materials and training programs accordingly and to motivate the workers to apply preventive measures.

**PART I**

Part I (Objectives) of the brochure concerns symptoms, risk factors and basic principles of prevention. The term ‘musculoskeletal disorders’ denotes a group of health disorders of the locomotor apparatus such as muscles, tendons, skeleton, cartilage, ligaments and nerves. The symptoms span the whole spectrum from rather moderately impaired well-being up to irreversible, disabling injuries.

Injuries of the back are the most frequent and amount to approximately 60 per cent of cases. They are followed by injuries of the neck and upper extremities, which include the increasing number of cumulative trauma disorders (CTDs) and repetitive strain injuries (RSIs).

Health problems are expected, in particular, if mechanical workloads exceed the load-bearing capacity of the musculoskeletal system. These are injuries of muscles and tendons, ligaments, and bones, irritations at the insertion points of muscles and tendons, as well as functional restrictions and premature degeneration of bones and cartilage.

**Mechanical overload**

Mechanical overload, which is defined as the risks that frequently lead to muscle-skeletal disorders are:

- High-force exertions (manual material handling of heavy objects);
- Frequently repeated manipulation of objects over many years;
- Long-term handling of loads;
- Bad posture;
- Static muscular load and muscular inactivity;
- Monotonous repetitive manipulations;
- Exposure to vibration.

Physical environmental and psychosocial factors are additional contributors. The injuries are caused either by strong and short-term heavy loads leading to sudden and painful failures in structure and function, or they result from permanent overloads, that lead to continuously increasing pain and dysfunction.

**Preventive measures**

Preventive measures follow the basic principle of ergonomics. This consists of the creation of an appropriate balance between the requirements of the work and the capacity of the worker, either by adapting the work to the requirements of the worker or by developing the worker's capacity by training.

Priority is given to the suitable design of working conditions to the capacity of workers, while considering individual factors such as age and gender. The aim is to achieve a balance between activity and rest and to avoid overload as well as inactivity. Additionally, the worker must be instructed about the method of performing the work in order to avoid bad posture, adequate pace etc.

**PART II**

Part II (Guidance) of the brochure gives concrete examples by describing the relevant tasks and working conditions for the most significant risk factors. It explains why they are harmful, and provides suitable preventive measures to be introduced by the employers and applied by the workers.

**Heavy loads**

The main risk described in the brochure results from 'manipulation of heavy loads', that is lifting and carrying heavy objects in transportation jobs, construction industries, as well as in nursing professions. To reduce the risk, workers must lift with both hands, symmetrically to the body while bringing the load close to the body. The use of cranes, lifters, dollies, hoists, pallet jacks or mobile elevators are recommended.

The employer shall establish measures to minimize the risk by avoiding the moving of loads over obstacles, uneven or slippery routes or steps, by labelling heavy loads, non-symmetrical load distribution, containers or barrels with movable contents and by providing suitable instructions (training of handlers).

Other frequently occurring risks that are described in the same way as in this just presented example are:

- ‘Exertion of high forces’ that occur while pushing or pulling heavy objects in transportation jobs and in health care;
- ‘Working in unfavourable body postures’ which is for instance performed in construction work, when working over head, in extremely bent, twisted, extended or inclined posture;
- ‘Monotonous repetitive tasks’ that are typical for assembly lines and cash registration consist of the execution of similar movements at high repetition rates, where the worker has little influence on the working pace and cannot abandon the workplace without being replaced by another person.
- ‘Long-lasting loads’, such as holding objects or tools over long periods which are typical in overhead painting, the fixation of a certain posture for
bricklaying at floor level or for work with a computer mouse.

- ‘Physical conditions at the workplace’ which may contribute to musculoskeletal disorders are for example:
  - using of hand-held tools and sitting or standing on vibrating machinery thus causing premature degenerative disorders;
  - working in the heat which accelerates the increase of core body temperature during the manipulation of heavy loads; low temperatures on the other hand impair dexterity.
  - insufficient illumination that induces constraint postures and increases the risk of stumbling or falling.

**Basic rules for preventive actions**

In practice the basic rules for preventive actions are the avoidance of unbalanced relations between the loads and the functional capacity of the worker. The maintenance and promotion of worker’s health recommends therefore:

- a weighed balance between physical activity and recovery by alternating between periods with higher load and periods of relaxation;
- the reduction of forces and repetitions; and
- the avoidance of too low loads.

The primary aim is the adaptation of working conditions to the capacity of the worker, while taking into account individual factors such as age, gender, training level, and the state of knowledge.

The ergonomic design of work must consider body positions and postures, movement sequences, energetic loads, work-rest cycles, repetition and duration of work, the arrangement of instruments at the workplace and mental loads associated with the latitude and control of work or job enrichment.

A secondary aim is the development of the workers’ capacity by training and vocational adjustment. The selection of workers according to individual capacity should be limited to exceptional situations.

Successful prevention of work-related health risks requires a scheduled and stepwise procedure that includes:

- analysis of working conditions;
- assessment of professional risk factors;
- ergonomic design of the workplace (prevention in the field of working conditions);
- influencing the behaviour of the workers (prevention in the field of behaviour);
- co-ordination of prevention measures with all persons involved; and
- control and assessment of the results.

**Related websites**:
http://www.osha-slc.gov/ergonomics-standard/
http://www.hse.gov.uk/msd/
http://www.cdc.gov/niosh/ergosci1.html

**Presentation of a Health Network**: HIF-net at WHO is an e-mail discussion list dedicated to issues of health information access in resource-poor settings. Launched in July 2000 in collaboration with WHO, the list is moderated, focused, and text-only. The list has more than 850 subscribers worldwide, including health professionals, librarians, publishers, NGOs, and international agencies. More than 40% of subscribers are based in developing and emerging countries and we would like to see more occupational health issues emerging from this very good discussion group. Send an e-mail to find out if the HIF-net can be useful for you (net@who.int) and how you can contribute. To join HIF-net at WHO, e-mail your name, affiliation and professional interests to health@inasp.info.
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Global Occupational Health Network (GOHNET)
Survey
Application form for GOHNET membership

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